

# **The Chemistry of Toothpaste**

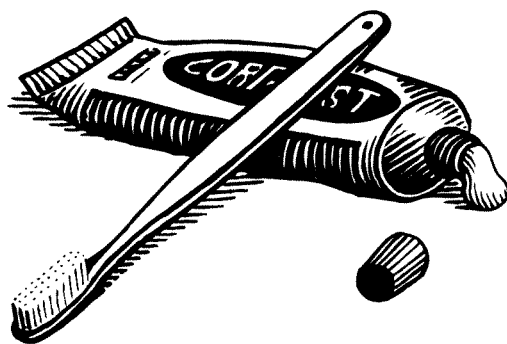
**Before we begin chemical analysis of toothpaste in the lab you will need to do some background research. Working alone or in small groups, research and answer the following:**

## **Teeth:**

- 1. How and when do teeth form?**
- 2. How do nutrition and water affect tooth development?**
- 3. What are the parts of a tooth and what does each part do?**
- 4. Why are teeth different shapes?**

## **Toothpaste:**

- 1. Why do we brush our teeth**
- 2. What are the 2 main functions of toothpaste?**
- 3. What is an abrasive and why is it used in toothpaste?**
- 4. Which chemicals in toothpaste clean your teeth and how do they work?**
- 5. What is the role of Flouride in dental hygiene?**
- 6. What is the difference between active and inactive ingredients in a toothpaste?**
- 7. What are the active ingredients in a toothpaste and what do they do?**
- 8. What are the inactive ingredients in a toothpaste and what do they do?**





# The Science of Toothpaste

## An Everyday Consumer Lab

Name \_\_\_\_\_

### Overview:

The key to keeping teeth free of cavities involves the removal of plaque. To be effective, the abrasive agent must be harsh enough to remove accumulated plaque, yet not grind away tooth enamel.

In this lab you will interpret and characterize abrasion patterns of various toothpaste samples to identify particular abrasive types "heavy," "light," or "polishing."

### Materials:

5 coverslips	15 microscope slides
Microscope	Spot plate
Toothpicks	Magnifying glass
Toothpaste sample	Wax pencil
Pipet	Polarizers
Paper towel	

### Procedure:

#### Part A – slide preparation

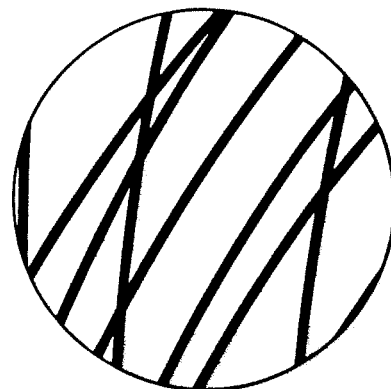
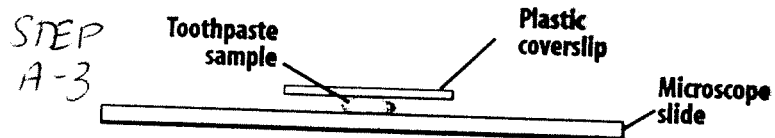
1. collect spot plate of toothpaste samples, microscope slides and coverslips
2. use a toothpick to apply a SMALL amount of a numbered toothpaste sample to the center a cover slip
3. apply the coverslip with the sample to the CENTER of a microscope slide
4. hold the microscope slide and coverslip between your thumb and forefinger
5. GENTLY apply pressure with your thumb while rotating the coverslip in a circular path 20 times
6. Bring your microscope slide and coverslip to the sink
7. Carefully rinse the toothpaste off the coverslip and microscope slide
8. Carefully dry both the coverslip and slide
9. Using the wax pencil, label the corner of the coverslip with the number of the sample being tested.
10. Repeat steps 2-9 for all four of the remaining samples.

#### Part B – viewing abrasions

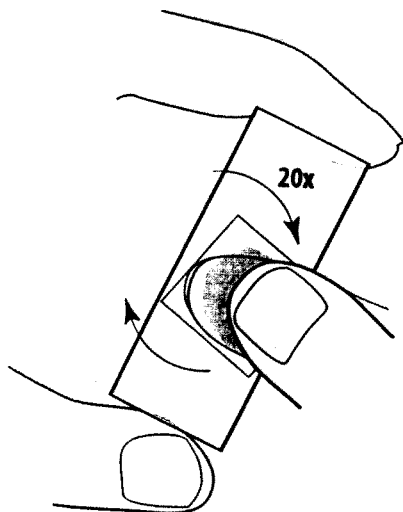
1. Place the prepared coverslip on the center of a dry microscope slide
2. place the microscope slide on the microscope stage
3. view the abrasions under low magnification
4. Draw what you see
5. characterize the abrasions according to the reference guide
6. repeat steps 1-5 for each sample

# REFERENCE PAGE

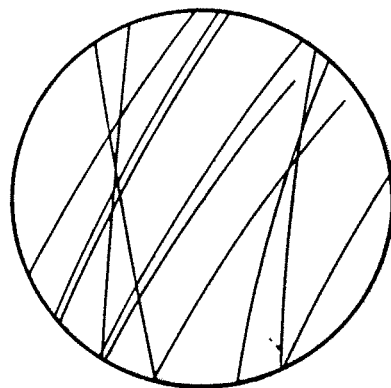
**Heavy Abrasive:** abrasion marks are wide.



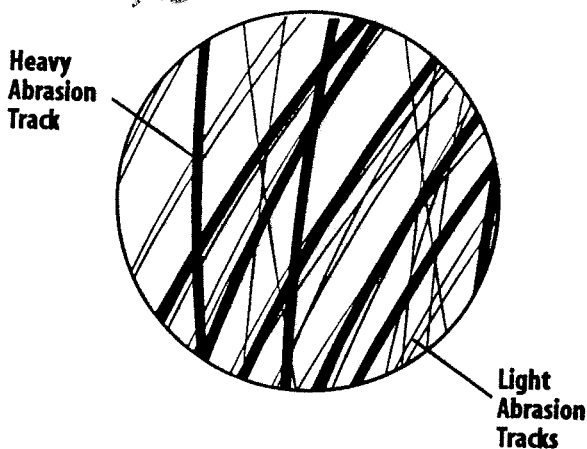
STEP A-5



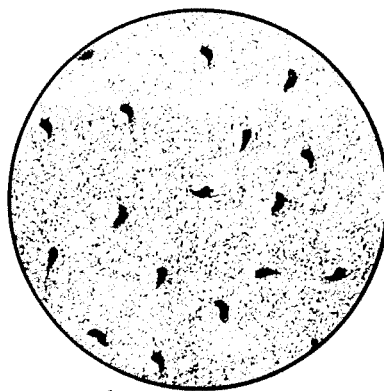
**Light Abrasive:** abrasion marks are thin.



## EXAMPLE OF MULTIPLE ABRASIONS



**Polishing Abrasive:** abrasion marks are diffuse. Markings range from tiny "comma" (,) markings to a "frosted" or "hazy" background pattern.



## Observations

Draw the abrasion pattern you see for each slide viewed under the microscope. Be sure to MATCH the sample number to the coverslide number.

Sample 1	Sample 2	Sample 3	Sample 4	Sample 5

## Data Table 1

Shade in or circle the appropriate description for each box.

Sample Number	Abrasion Types	Biffringent	Baking soda	pH	Fluoride test
<b>1</b>	◊ Polishing ◊ Light ◊ Heavy	◊ Yes ◊ No	◊ Yes ◊ No	◊ 6.0 – 6.9 ◊ 7.0 - 7.9 ◊ 8.0 – 8.9	◊ Positive ◊ Negative
<b>2</b>	◊ Polishing ◊ Light ◊ Heavy	◊ Yes ◊ No	◊ Yes ◊ No	◊ 6.0 – 6.9 ◊ 7.0 - 7.9 ◊ 8.0 – 8.9	◊ Positive ◊ Negative
<b>3</b>	◊ Polishing ◊ Light ◊ Heavy	◊ Yes ◊ No	◊ Yes ◊ No	◊ 6.0 – 6.9 ◊ 7.0 - 7.9 ◊ 8.0 – 8.9	◊ Positive ◊ Negative
<b>4</b>	◊ Polishing ◊ Light ◊ Heavy	◊ Yes ◊ No	◊ Yes ◊ No	◊ 6.0 – 6.9 ◊ 7.0 - 7.9 ◊ 8.0 – 8.9	◊ Positive ◊ Negative
<b>5</b>	◊ Polishing ◊ Light ◊ Heavy	◊ Yes ◊ No	◊ Yes ◊ No	◊ 6.0 – 6.9 ◊ 7.0 - 7.9 ◊ 8.0 – 8.9	◊ Positive ◊ Negative

## The Science of Toothpaste

An Everyday Consumer Lab

Name \_\_\_\_\_

### Overview:

Carbonates are common abrasives used in toothpaste. These crystalline materials are **insoluble** in water and have unique optical properties – “**birefringence**” – which allows us to detect their presence using polarized lighting.

Birefringence is the ability of some transparent materials to be “double refractive.” This means that you can see a pattern of colors under polarized lighting conditions.

A microscope can be used to observe the effects of polarization by placing polarizers above the eyepiece and below the specimen. Once in place, you rotate the polarizer above the eyepiece until you obtain “crossed polarized light” or a black field.

### Common Birefringent Abrasives

Name	Comment	Abrasive Type
Calcium Carbonate	Common; large crystal; glows brightly; insoluble in water	Heavy
Dicalcium Phosphate	Common; smaller crystals; glows less brightly; insoluble in water	Light
Sodium Bicarbonate	Common; Large crystals; glows less brightly; soluble in water	Polisher and cleansing agent

### Materials:

Paper towel	10 microscope slides
Microscope	Spot plate
Toothpicks	Magnifying glass
Toothpaste sample	Wax pencil
Pipet	Polarizers

### Procedure:

#### Part A – slide preparation

1. collect your materials from the teacher
2. using a toothpick, place a “dab” of sample in the center of a clean microscope slide
3. place another slide on top of the sample to make a “sandwich”
4. gently press the slides together so a thin layer of toothpaste is formed

- a. it must be thin enough for light to pass through
5. mark the edge of the slide with the sample number
6. repeat steps 2-5 for all toothpaste samples.

### **Part B – viewing birefringence**

1. Place the toothpaste “sandwich” on the microscope stage
2. focus the slide under LOW magnification
3. place the polarizing film on the eyepiece
4. rotate the film so that a black background is viewed
5. look through the film onto the microscope slide
6. scan for material that “glows” or looks bright against a black background
7. rotate the film until a lighter “normal viewing” background appears – compare the difference
8. repeat steps 1-7 for each sample.
9. record your observations and mark your findings in your data table (from lab 1 – abrasions)

### **Observations**

Record any observations you have of birefringence Be sure to MATCH the sample number to the slide number.

Sample 1	Sample 2	Sample 3	Sample 4	Sample 5

### **Data Table 1**

\*\*Shade in or circle the appropriate description for each box found in your day one packet

## The Science of Toothpaste

An Everyday Consumer Lab

Name \_\_\_\_\_

### Overview:

Carbonates are common abrasives used in toothpaste. Carbonate presence can be detected by a simple reaction test. If a weak acid, like white vinegar, is added to sodium bicarbonate a chemical reaction occurs and carbon dioxide gas is given off.

### Materials:

Paper towel	2 Spot plates
Small cup of Vinegar	pipet
Toothpicks	Magnifying glass
Toothpaste sample	Wax pencil
Pipet	

### Procedure:

#### Part A – preparation

1. collect your materials from the teacher
2. label your empty spot plate with numbers 1-5
3. using a toothpick, carefully place a sample of each toothpaste in the bottom of the spot well (by its corresponding number)
4. add 5 drops of vinegar (from the small cup) to each well

#### Part B – viewing

5. use a magnifying lens to carefully observe with samples bubble
  - a. bubbles are present when there is a significant generation of CO<sub>2</sub>
6. Record your observations and record your findings in the data table

CLEAN UP: WASH AND DRY ALL MATERIALS; RETURN THEM TO THE TEACHER

### Observations

Record any observations you have of bubbling. Be sure to MATCH the sample number to the slide number.

Sample 1	Sample 2	Sample 3	Sample 4	Sample 5



**Data Table 1**

Shade in or circle the appropriate description for each box found in your day one packet

## The Science of Toothpaste

An Everyday Consumer Lab

Name \_\_\_\_\_

### Overview:

Today most toothpaste products produced and marketed in the US contain between 1100 – 1500ppm fluoride ion. This is an active ingredient that aids in strengthening teeth.

### Materials:

Paper towel	Spot plate
Fluoride reagent	pipet
Toothpicks	Magnifying glass
Toothpaste sample	Wax pencil

### Procedure:

#### Part A – preparation

1. collect your spotplate with labeled toothpaste samples
2. use a pipet to add 10 drops of water to each sample
3. mix each sample with a different toothpick
4. add 1 drop of fluoride ion reagent to each sample.
5. watch for a color reaction
  - a. yellow, orange, pink = fluoride positive
  - b. Purple = fluoride negative

### Observations

Record any observations you have of color change. Be sure to MATCH the sample number to the slide number.

Sample 1	Sample 2	Sample 3	Sample 4	Sample 5

### Data Table 1

Shade in or circle the appropriate description for each box found in your day one packet

# The Science of Toothpaste

## An Everyday Consumer Lab

Name \_\_\_\_\_

### Overview:

Saliva contains calcium and phosphate ions which naturally replace any that might be removed by mouth acids caused by plaque formation. Regular brushing removes plaque and allows remineralization to occur. In this lab you will design a test to compare the pH of toothpaste to that of mouth saliva (usually pH 6.8 – or slightly acidic).

### Materials:

Paper towel	Spot plate
pH strips	pipet
Toothpicks	Magnifying glass
Toothpaste sample	Wax pencil

### Write a Procedure to test the pH of toothpaste:

1. collect your spotplate with labeled toothpaste samples

2. \_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_
4. \_\_\_\_\_  
\_\_\_\_\_
5. \_\_\_\_\_  
\_\_\_\_\_
6. \_\_\_\_\_  
\_\_\_\_\_
7. \_\_\_\_\_  
\_\_\_\_\_
8. \_\_\_\_\_  
\_\_\_\_\_
9. \_\_\_\_\_  
\_\_\_\_\_

10. \_\_\_\_\_  
\_\_\_\_\_

**Get this procedure signed by your teacher BEFORE you conduct the experiment!!**

\_\_\_\_\_  
teacher signature

**Conduct the experiment.**

**Observations**

Record any observations you have pH measurements. Be sure to MATCH the sample number to the slide number.

Sample 1	Sample 2	Sample 3	Sample 4	Sample 5

**Data Table 1**

Shade in or circle the appropriate description for each box found in your day one packet